Light and Lighting

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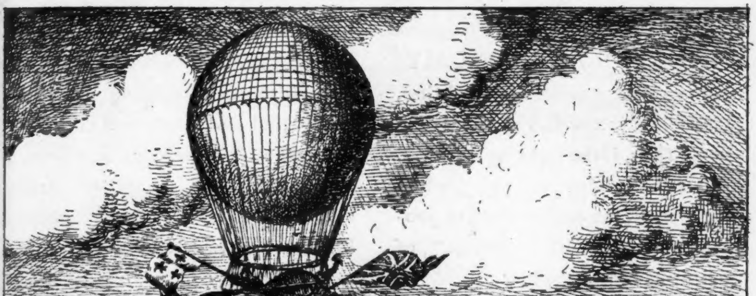

FIRST CHANNEL CROSSING BY AIR. A representation of the departure of Monsieur Blanchard and Dr. Jefferies from Dover Castle on January 7th, 1785. This was the first occasion on which the English Channel had been crossed by air.

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Light and Lighting

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CONTENTS

Delight

WHAT a spontaneous demonstration of delight was evoked on April 2nd when the lights we have missed for ten long years shone out once more! Only a few months ago the lighting of the fountains in Trafalgar Square brought similar evidence that light lightens our hearts as well as our eyes. Not that we needed such evidence; for we know only too well the gladdening effect of light—as men have known it from time immemorial. Solomon was never wiser than in recognising this truth and expressing it so simply, "Truly the light is sweet." Yet, strangely enough, how often still the cheering influence of abundant light is denied to people in their workplaces. Of what use is the clamour for greater productivity if the energies of men are not released as fully as may be by the potent agency of light? Out of working hours, however, how welcome are the lights we have now regained; may they be augmented and refined but never lost again!

Illumination Notes and News

Training In Illuminating Engineering

During the last few years the City and Guilds examinations in illuminating engineering have come to be recognised as of some importance to both the practising lighting engineer and to the lighting industry as a whole. Firms in the industry are now beginning to require that applicants for positions on their staff shall hold at least the Intermediate grade certificate. This is of benefit to the industry and will add to the status of the lighting engineer.

Though courses for the Intermediate examination have been arranged in many parts of the country it is still very difficult for students, once having taken the Inter., to continue their studies to take the Final examinations. The only courses at the present time are those at the Borough and Northampton Polytechnics in London and at the Stowe College School in Glasgow. Students out of reach of these places are dependent therefore on either correspondence courses or private study. It would seem that there is not yet a correspondence course for the Final examination for such students and their only possibility is therefore private study.

It is understood that the I.E.S. have given some thought to this problem of students who are unfortunately halted in the middle of their studies and are considering the possibility of starting local study groups in those Centres where arrangements for proper courses cannot be made. In brief it appears that the idea is that where there are, say, one or two such students arrangements might be made for them to meet and discuss any problems they meet in their studies with one or two experienced members of their local Centre. It is a case of helping these students over any obstacles they may meet. Arrangements might also be made for the loan of text-books. Nothing like a formal course or class is intended. The suggested arrangements are intended for Section "B" of the Final examination only.

Before proceeding with these ideas the I.E.S. Education Committee would like to know how many I.E.S. members are in the position of being unable to continue their studies for the Final examination Section "B." I.E.S. members who are interested in this scheme, either as students or as possible helpers, are invited to communicate with the secretary of the I.E.S.

The Next I.E.S. Meeting in London

The *Annual General Meeting* of the I.E.S. is to take place at the Royal Society of Arts, John Adam Street, London, W.C.2, at 6 p.m. on Tuesday, May 10.

After the formal business has been concluded, an address is to be given by Monsieur L. Gaymard, of Paris, who is Chief Engineer in the Street Lighting Department of Electricité de France.

Next I.E.S. Summer Meeting

It is announced that following the success of the I.E.S. Harrogate summer meeting arrangements are now being made for a similar function to be held at Buxton in May, 1950.

One of the comments, and possibly the only adverse comment on an otherwise well-organised conference, on the Harrogate meeting was that insufficient time was allowed for discussion of the various technical papers. This, we understand, is being borne in mind in arranging the Buxton meeting, which is to be one day longer in duration than the first summer meeting. The Buxton meeting will take place from Tuesday, May 16, to Friday, May 19, 1950.

Concerning MSS.

There are sundry reference books which give hints and advice on the preparation and submission of manuscripts. In addition, many scientific societies and institutions, including our own I.E.S., have issued from time to time recommendations to authors. These remarks are addressed to possible contributors to this journal who may be trying their hands at journalism for the first time and who may be unaware of such reference books and recommendations.

It is doubtful if there is anything that annoys an editor more than a badly presented MS., and the author who ignores one or two simple rules makes life very difficult for the editor and printer and increases the chances of having his MS. rejected. Probably the most common fault is to type MS. in single spacing instead of double. Double spacing is necessary so that corrections and instructions to the printer can be inserted. Plenty of space should be left at the top of the first sheet—again for printing instructions.

Line drawings should be in black ink on white paper or blue tracing linen. Ordinary tracing paper can be used, but it is not very satisfactory, particularly as it gets torn so easily, and drawings are sometimes handled many times before the blocks are eventually made. Drawings should *not* be folded—if too big to lay flat, then they should be rolled and protected in a cylinder. Lettering on line drawings should be large enough to withstand reduction, but if the author is in doubt he might save himself a lot of work by inserting the lettering in pencil, inking it in after the editor has decided on the scale of reduction. Photographs should be either whole plate (8½ in. x 6½ in.) or half plate (6½ in x 4¾ in.), and should, of course, be kept flat and protected in the post with stiff cardboard.

In Brief

The "Teacher's World," which we recently quoted on the subject of bad lighting in schools, has now reported another instance. It appears that in a certain Yorkshire school the only equipment for artificial lighting consists of three oil-lamps. As two of these are now broken, a single lamp has to be relied upon when the daylight is inadequate—and this, says the "Teacher's World," is the twentieth century!

The E.L.M.A. have arranged for two special lectures to be given at Northampton on April 21 to executives of the boot and shoe industry. The lecturers are Mr. M. W. Pierce, of the G.E.C., and Mr. H. C. Weston.

The Institute of Ophthalmology (University of London), which was recently opened as a Postgraduate Medical School and Research Institute, is equipped for fluorescent lighting, and we understand that this method of lighting is well liked. It is also interesting to note that fluorescent lighting is being installed in parts of University College Hospital.

A Spherical Integrator for Fluorescent Lamps

The development of tubular fluorescent lamps in sizes up to 9 ft. long, as in the cold cathode types, has led to the need for a spherical integrating photometer of large dimensions to measure luminous output, since the accuracy of the integration of luminous flux depends on the relative sizes of light source and integrating sphere. Such a photometer is also useful in assessing the output of some of the larger lighting fittings designed recently.

The illustration shows a 12 ft. sphere which has recently been completed at the Research Laboratories of the General Electric Co., Ltd., at Wembley. The sphere is constructed from rolled aluminium panels in an angle iron segmented framework, and is recessed in the floor so that the base is about 2½ ft. below floor level. A steel "gangplank," flush with the floor is mounted on roller bearings, so that it may easily be pushed through a 6 ft.-diameter opening in the side of the sphere, thus enabling the operator to walk to the centre of the sphere and set up the lamp to be measured at comfortable working height. In the illustration a lamp is being connected to the holder on the flex held by the operator.

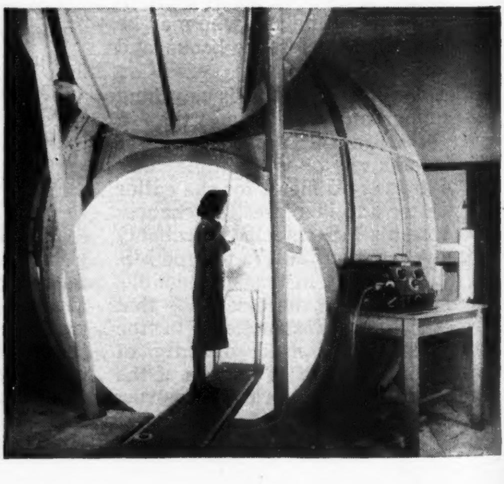
The door which closes the opening is suspended on chains and counterbalanced by cylindrical weights running inside the tubular members on which the door running rails are supported. It is raised and lowered by hoisting gear driven by an electric motor, and appropriately interlocked, both mechanically and electrically, with the gangplank and gate switches. The latter are provided as safety measures, since the photometer is occasionally used for determining the luminous output of high voltage electric discharge lamps.

Diffusing windows are fitted at four positions on the equator of the sphere, and suitable internal screens are arranged so as to prevent direct light from reaching the window used for measurement purposes. One of the screens is seen in the illustration beyond the right-hand tubular upright. The provision of more than one window allows measurements to be made with different forms of measuring apparatus, simultaneously if required.

The photo-electric measuring gear is seen on the right-hand side of the sphere. An emission type photo-cell is used in a D.C. valve bridge amplifier circuit. The photo-meter unit, comprising photo-cell, grid leaks and electrometer triode (sealed in an evacuated tubular bulb to ensure freedom from surface leakage troubles) is mounted in the vertical cylinder shown.

The photo-cell views the diffusing window through a liquid filter matched to the particular photo-cell used, so that the overall spectral sensitivity is close to that of the "average eye." The photometer, can, therefore, be calibrated by reference to tungsten filament standard lamps and subsequently used to measure light sources of widely differing spectral distributions, without involving appreciable errors.

The photometer unit is connected to the D.C. valve bridge amplifier in the control cabinet seen in the foreground, and measurements of luminous flux are made by observing the readings on the three potentiometer dials when the reflecting galvanometer inside the cabinet indicates that the bridge is balanced.



Manufacture of Lighting Fittings

At the I.E.S. London meeting on April 12 papers on the manufacture of lighting glass and the manufacture of metal parts for lighting fittings were presented by Mr. J. G. Holmes and Mr. P. Hartill respectively. Summaries of the two papers are as follows.

Lighting Glass

It was not until 30 or 40 years ago that scientific methods started to yield fundamental knowledge of the constitution of glass and to make rapid progress in the techniques of manufacture.

The physical properties of vitreous materials are significantly different from those of crystalline or organic substances in many respects. The optical properties are particularly important for lighting fittings, but due regard must be paid to the low thermal expansion co-efficient, the high moduli of elasticity and the statistical nature of the ultimate strength of a glass article in designing the fitting so as to avoid the risk of excessive stresses due to heat or distortion. The properties of refraction, reflection, absorption and diffusion are common to all transparent materials, but glass provides a very wide range of properties, from extreme transparency to great opacity or complete diffusion, which can be used very effectively by the designer. The property of refraction is perhaps the most useful, enabling a concentration of light to be obtained by a prismatic glass, the angles of the refracting elements being accurately formed by moulding the hot glass in a cast iron tool.

The manufacturing process starts with the melting of the raw materials in a furnace at a high temperature, allowing the liquid to become clear and homogeneous, and reducing the temperature until the glass is about as viscous as treacle, in which state it may be formed by several methods, including rolling, drawing, blowing, and pressing. The pressing process uses a closed iron mould into which a "gathering" or gob of red-hot glass is dropped before the mould parts are brought together, the mould being opened again immediately the glass has cooled sufficiently to become hard. The design of the mould has to be such that it can be opened without risk of cracking the glass, and yet a pressure of perhaps a ton may be exerted in order to force the glass exactly to the shape of the mould. Fortunately, the thermal expansion of cast iron up to 350 deg. C. is about the same as that of soda-lime glass up to its softening range around 600 deg. C., so the finished size of the pressing is closely the same as the original size of the mould.

Glass manufacture to-day represents one of the most highly mechanised and scientifically controlled production processes, whilst it still retains the traditions of craftsmanship associated with off-hand blowing.

Metal Parts

The paper briefly outlined some of the considerations involved in the design and construction of metal components of lighting fittings. The properties of commonly used metals were discussed, with particular reference to corrosion resistance, and figures were quoted indicating the natural life of untreated sheet metals. Data covering specific gravity, tensile strength and elongation were given for certain metals. The paper also described various methods of shaping, including spinning, pressing, bending, and casting, the limitations of individual processes being mentioned.

Various kinds of finishing for metals were reviewed in the paper. These included painting, vitreous enamelling, electro-plating, metal spraying, hot-dipping and forms of chemical treatment such as phosphating and oxidising processes. A description was given of anodising aluminium and its alloys, with special regard to reflectors. The importance of cleaning and preparation of surfaces before the application of protective coats was stressed, and methods described included degreasing, sand-blasting, and pickling. The question of the proximity of dissimilar metals in regard to the value of superficial metallic coatings and to the precautions to be taken in assembly of fittings is another important matter which was discussed.

The paper concluded with a discussion on metal reflectors, describing characteristics of different forms of surface treatment. Matters discussed included total and specular reflectivity.

An Analysis of the Lighting Problem of an Industrial Undertaking

By F. G. COPLAND, B.Eng., A.M.I.E.E., Assoc.I.Mech.E.

The material increases in statutory factory lighting requirements laid down in the Factories (Standards of Lighting) Regulations, 1941, in conjunction with accumulated arrears of plant maintenance, have produced a problem with which many engineers responsible for factory services are now called upon to deal.

The author's experience indicates that large portions of existing factory lighting installations will require alteration. It is thought, therefore, that a description of a rational approach to a large-scale relighting problem would be timely.

Before proceeding to discuss an analysis of the problem a basic assumption must be clearly understood. This is that some engineer on the staff of the undertaking in question has a knowledge of the fundamentals of illumination calculations. The engagement of a qualified engineer solely for lighting duties can be contemplated by only the largest firms, but knowledge adequate for the execution of the steps suggested later in the paper can be gained at one of the E.L.M.A. courses. These, held periodically, take one week to complete and, in conjunction with spare time study, will give normally qualified engineers a good grounding in illumination calculations. The salary and expenses for one week of an assistant engineer are negligible in comparison with the cost of relighting on the scale with which this paper is concerned.

Analysis

A relighting problem can be resolved into the following parts:—

1. A survey of the scope and magnitude of the relighting requirements.
2. Provision of the necessary finance.
3. Reduction of the extra work involved to a minimum.
4. The inclusion of relighting in the overall engineering programme of the factory concerned.

In order to clarify an explanation of the steps suggested by the author to deal with these parts, it is proposed to create an imaginary works. Fig 1 shows a plan of the site of a works which is quite small, but large enough to serve as an illustration of method.

Initial Survey

The first step is to prepare a schedule of all parts of the plant which will be lit as units, and to mark these off on a plan. For example, the foundry floor area includes, possibly, a pattern store, core making, core ovens, casting floor, sand treatment, fettling bay, etc. Lighting requirements may vary between these areas and each will therefore be regarded as a lighting unit. No attempt has been made to do this in Fig. 1 Next, it is necessary to make a photometric survey of the existing lighting conditions. For purposes of initial calculations, maximum and minimum readings in each area will be adequate, the mean being taken as an average. Such a survey may appear a formidable task in the case of a large works, but in a survey supervised by the author, the rate of approximately 1,000,000 square feet of floor area in 24 working hours was maintained by an electrician of chargehand status, with a labourer. Since the readings had to be taken after dark and the survey was made in the spring, these hours were at overtime rates, but the cost was a completely insignificant fraction of the cost of the programme which the survey initiated.

Table I suggests the sort of data which might result from a survey of the imaginary works. The areas (sq. ft.) shown are taken from the works plan; the number of employees and the hours worked in each area were obtainable from the departmental foreman. The usefulness of this data will emerge later. A point to remember is that whilst the lighting in certain areas may exceed statutory or desirable minimum values, the type of fitting used may not

comply with regulations as regards cut-off. Hence a note of the type of existing fitting in each area should be included in the survey.

At this stage it is desirable, if possible, to decide upon the standard of modern lighting to be employed. A firm planning on a long-term basis will adopt the standards recommended by the I.E.S. for the type of work carried out, which should cover any foreseeable change in the regulations. If, however, financial or other considerations so dictate, then the statutory minimum of 6 lm./sq. ft. will be worked to. The relation of the existing lighting to whichever standard is adopted, or to both if a comparison is required, is included in the survey schedule.

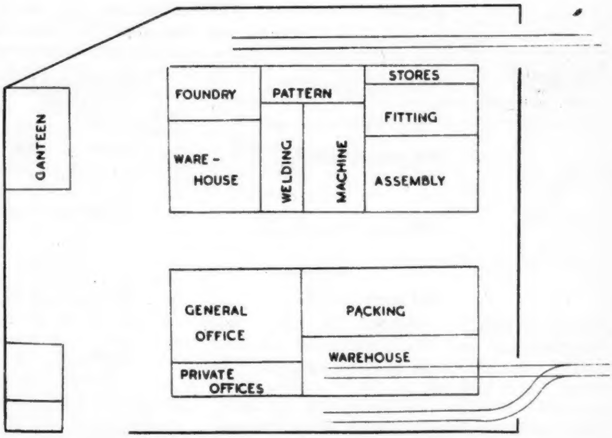


Fig. 1. Diagrammatic plan of a factory.

The schedule establishes the amount of relighting required. Those familiar with lighting measurements will no doubt agree that, recalling the lighting in works they have visited, the proportion is likely to be a high one.

The completion of the survey disposes of part one of the analysis.

Table 1.

PART OF SURVEY SCHEDULE

Site	Area sq. ft.	Lm./sq. ft.			Reccd. Lm./sq. ft.	Per cent. of Reccd. level	Per cent. of Stat. level	No. of employees	Hours worked	Type of lighting fitting in use
		Max.	Min.	Av.						
Offices, Gen.	20,000	11	4	7.5	20	37	—	68	O.H.	Opal Spheres
,, Priv.	3,000	12	2	7.0	15	46	—	20	O.H.	Various
Packing	50,000	3	1.5	2.25	6	37	37	15	W.H.	Well glass
Warehouse	50,000	1.8	0.7	1.25	6	20	20	8	W.H.	,, ,,
Foundry	8,000	0.7	0.3	0.5	10	5	8	27	C.S.	Various
Pattern Shop	2,000	8.0	4.0	6.0	15	40	100	10	W.H.	Dispersive
Welding	3,000	9.0	7.0	8.0	15	53	100	16	,,	,,
Machine shop	8,000	11.0	8.5	9.75	10	97	100	70	,,	Local and Well glass
Canteen	5,000	8.0	7.0	7.5	10	75	—	8	,,	Dispersive
Stores	1,000	2.0	0.7	1.35	6	22	22	3	,,	Well glass
Fitting shop	20,000	3.5	1.7	2.6	10	26	43	60	,,	High bay
Assembly	30,000	12.0	2.0	7.0	20	35	100	138	,,	,, ,,

Note that the "break-up" of main areas into "lighting areas" is not indicated. Areas are taken from the works plan, and the remaining figures obtained during the photometric survey.

D

Table 2.

AREA PER FITTING

Illumination value Lm./sq. ft.	Type of fitting	$\frac{\text{Lamp Lumens x C. of U.}}{\text{Lm./sq. ft.}}$ =	Sq. ft. per fitting.
20	300 watt Diffusing	$\frac{4430 \times 0.35}{20}$	77.5
	80 watt Fluorescent	$\frac{3040 \times 0.4}{20}$	60.8
15	300 watt Diffusing	$\frac{4430 \times 0.35}{15}$	103
	80 watt Fluorescent	$\frac{3040 \times 0.4}{15}$	81
10	300 watt Diffusing	$\frac{4430 \times 0.42}{10}$	186
	80 watt Fluorescent	$\frac{3040 \times 0.5}{10}$	152
6	300 watt Dispersive	$\frac{4430 \times 0.5}{6}$	369
	80 watt Fluorescent	$\frac{3040 \times 0.5}{6}$	253

4,430 and 3,040 are the lumen outputs of a 300 watt tungsten lamp and an 80 watt fluorescent tube respectively. The coefficients of utilisation are average figures based on the average size of lighting area (normally greater in the factory areas), the state of decoration, available mounting heights, shape of lighting area and the type of fitting proposed.

The Financial Analysis

In order to deal with part two, the provision of the necessary finance, the works engineer must prepare a scheme, cost it, and submit his recommendations to higher authority for approval.

For the purpose of a general treatment, which at this stage is all that is required, two alternatives present themselves, i.e., tungsten and fluorescent lighting. Sodium and mercury discharge lighting cannot be regarded as generally suitable for works interior use. The survey, it will have been noted, does not include the exterior portions of the works. These areas form a problem of a different kind, usually not suited to a generalised treatment.

The works engineer then must prepare estimates of the costs of relighting by tungsten and by fluorescent lamps. To keep the analysis within reasonable bounds he will ignore areas requiring special values or types of lighting, e.g., laboratories, executive private offices, etc., unless these form a significant part of the whole, which would be unusual. He will decide on sizes and types of fitting which will have a general application, his choice being guided by such considerations as mounting height, etc. It will be found that quite a limited selection will cover most requirements and for the imaginary works it will be considered that 300 watt diffusing fittings are suitable for all areas except the stores, packing shed and warehouse, where 300 watt dispersive types will be quite adequate. Open inverted trough fluorescent fittings are suitable for use everywhere. Since it is desired only to illustrate a method, only I.E.S. recommended illumination values will be considered.

From a consideration of average

values of such factors as available mounting height, amount of window space, colour and state of decorations, average size of unit area, etc., average co-efficients of utilisation for office and works areas can be calculated, and from these, with the addition of a maintenance factor, an "area per fitting" obtained for each value of illumination it is proposed to install. Those applicable to the works under inspection are shown in Table 2.

Also required is the cost of installing each type of fitting. The engineer knows, or should know, the average cost of wiring to a light point in his works. If necessary a contractor will soon provide him with a figure. That used by the author is £4 per point, covering conduit type wiring and including an allowance for an average number of switches, but excluding the lighting fitting itself. Nor does it include mains feeds to the area concerned, which are properly a distribution charge. Three-hundred watt diffusing fittings cost £3.75 each, with tungsten lamp, dispersives £2.375. Twin fluorescent (80 watt) of industrial type (without purchase tax) cost £13.5, singles £8, complete with tubes, giving an average of £7.2 per tube, which is used in the author's analysis. Table 3 lists these values.

The next step is to summate those areas with similar illumination values

Table 3.

COST PER POINT

Item	Tungsten	Fluorescent
Wiring ...	£4	£4
Diffusing Fitting ...	£3.75	£7.2 (*)
Dispersive Fitting ...	£2.375	£7.2 (*)

$(*) = \frac{£13.5 + £8}{3}$

and types of lighting. Table 4 shows this in schedule form for the imaginary works we are considering. The steps taken to fill in the five right hand columns are obvious. At the foot of the table the costs of the tungsten and fluorescent alternatives are totalled. The fluorescent installation is the more expensive, but first cost is not the only, even if an important, consideration.

Annual costs, with which the works engineer will mainly be concerned, are principally made up of:—

1. Capital charges.
2. Maximum demand charges for electricity.
3. Unit charges for electricity.
4. Lamp replacements.

The rate of capital replacements will

Table 4.

Area sq./ft.	Lm./sq./ft.	Type of Fitting	Area per Fitting	No. of Points	Cost per Point £	Cost £	kw.
50,000	20	300 watt Diff.	77.5	645	7.75	5,000	193
		80 watt Fl.	60.8	823	11.2	9,230	74
8,000	15	300 watt Diff.	103	78	7.75	605	23
		80 watt Fl.	81	99	11.2	1,110	9
41,000	10	300 watt Diff.	186	220	7.75	1,705	66
		80 watt Fl.	152	270	11.2	3,025	24
101,000	6	300 watt Disp.	369	274	6.375	1,745	82
		80 watt Fl.	253	400	11.2	4,480	36
	Tung.	Fl.					
Total Cost...	£9,055	£17,845					
,, kw ...	364	143					

The left-hand column summates areas of similar illumination intensity, indicated in Col. 2, and the remaining columns are calculated from the data previously assessed.

be laid down by the works accountant. Wiring is generally written off over 20 years, which involves an annual charge of 5 per cent. Fittings may be repaid at 5 per cent. for 20 years or 10 per cent. for 10 years—figures vary considerably with different organisations. 10 per cent., rather a pessimistic figure, will be used in this analysis. In Table 5 these replacement charges are indicated.

Table 6 indicates the method of assessing the M.D. charge. The tariff shown is typical and a recent coal cost is used. The M.D. charged is that occurring between November and February inclusive. Since it is logical to assume that all lighting will be in use on winter evenings at the same time as the factory power load, no diversity factor has been applied, i.e., it is assumed that the whole of the lighting will form part of the chargeable M.D. Thus the installed kw. for tungsten and fluorescent lighting, multiplied by £4, the M.D. charge, gives the respective annual M.D. costs.

Rather more calculation is required to obtain the cost of the units consumed. It is first necessary to determine the

Table 5.

CAPITAL CHARGES

	Tungsten	Fluorescent
Number of Points	1,217	1,592
Wiring Cost ...	£4,868	£7,368
Fittings—cost ...	£4,187	£10,477
Total cost ...	£9,055	£17,845
Wiring at 5% ...	£243	£368
Fittings at 10%	£418	£1,047
Annual Charge ...	£661	£1,415

Table 6.

ELECTRICITY TARIFF

M.D. CHARGE. £4 per kw. of Maximum Demand.

UNIT CHARGE. 0.28d. per unit + (0.0009d. per 1d. over 15s. per ton of coal).

With coal at 50s. per ton
= 0.28 + 0.378
= 0.658d. per unit.

M.D. CHARGE

	Tungsten	Fluorescent
Installed kw	364	143
Annual Charge at £4...	£1,456	£572

Table 7.

UNIT CHARGE

Annual hours of use—" Continuous shift " 5280
" Office hours " 352
" Works hours " 484

Site	Sq. ft.	Lm./sq. ft.	Kw. Loading		Annual hours	Units per Annum	
			Tungsten	Fluorescent		Tungsten	Fluorescent
Offices ...	20,000	20	77	29	352	27,000	10,200
,, ...	3,000	15	8.5	3.5	352	3,000	1,250
Works ...	30,000	20	116	45	484	56,000	21,800
,, ...	5,000	15	14.5	5.5	484	7,000	2,660
,, ...	33,000	10	53	19	484	25,600	9,180
,, ...	8,000	10	13	5	5,280	68,600	26,400
,, ...	101,000	6	82	36	484	39,600	17,400
					TOTAL	226,800	88,890
					at 0.658 per unit ...	£621	£244

Here areas of similar illumination intensity and hours of use are summated (note the segregation of 8,000 sq. ft. of Foundry with 5,280 hours of use annually). Kw. loadings are proportional to the areas and the product of kw. loading and hours of use gives the units consumed annually.

hours of use of the lighting. The method suggested by the author is to obtain, from published curves, the annual hours during which daylight falls below 500 lm/sq. ft. and to assume that artificial lighting is necessary in the works at these times. It is not proposed to detail this lengthy but not difficult calculation—the resultant totals are given in Table 7. It is assumed that ordinary day work obtains in the office and works of the imaginary factory but the foundry, due to lack of space, is working continuously. Table 7, then, indicates the method of calculation of units consumed, and the consequent annual charge.

The remaining annual charge, lamp replacements, for tungsten and fluorescent lamps, are calculated in Table 8 and are shown to be closely similar.

A summary of the four annual charges is shown in Table 9, and the analysis is complete.

Other Factors

The function of the works engineer is now to submit this analysis and its results to those responsible for the financial policy of the firm, in the form of a report embodying his recommendations. To the factual data he should add his comments on factors affecting a decision which are not easily expressed in terms of £ s. d. Where present lighting conditions are so bad that conformity with regulations and/or desirable standards will mean a major addition to the factory load, the cost of additional switchgear, mains and possibly transformer capacity, of the order of £5 to £8 per kw., must be taken into consideration.

Possible revisions in working hours will affect the annual unit charge. In both of these possibilities the superior efficiency of the fluorescent lamp gives it a distinct advantage over the tungsten alternative. It should also be pointed out that, whilst tungsten lamps and fittings must be considered to have reached some degree of finality in efficiency and price, fluorescent tubes and fittings, and most particularly their control and starting gear, must be expected to make considerable progress in the next decade.

To those not familiar with illumination terminology a short explanation of

Table 9.

COMPARISON OF COSTS

	Tungsten	Fluorescent
Capital Outlay	£9,055	£17,845
Annual Charges :		
Capital ...	£661	£1,415
kw.	£1,456	£572
Units	£621	£244
Lamps ...	£187	£198
Total Annual Charge	£2,925	£2,429

Net Saving, £496
=5.7 per cent. on additional outlay (£8,790)

Table 8.

LAMP REPLACEMENT

	Tungsten	Fluorescent	Remarks
Number of Lamps	1,217	1,592	
Life in hours	1,000	3,000	
Number of replacements at 3,000 hours ...	3,651	1,592	
Cost per lamp	4.75/-	16.0/-	
Total lamp cost	£867	£1,275	
Man-hours per lamp...	2/3	2/3	2 men, 24 lamps per 8-hour day = £3 10s.
Cost per lamp	2.9/-	2.9/-	
Labour cost per 3,000 hours	£529	£230	
Total cost ,, ,, ,, ...	£1,396	£1,485	
Cost per year	£140	£148	At 300 hours per year

The steps in this calculation are self-explanatory. The man-hours calculation is based on enquiries made of persons carrying out this type of work, and the wage cost includes such overheads as personnel service, etc.

the term "coefficient of utilisation" may be of interest. Briefly, it simply means that proportion of the light available which may be put to good use where it is needed. Starting with a bare bulb, light is radiated in all directions except directly upwards, where the cap blocks the way. Since the light is normally required below the lamp level, a reflector is fitted to redirect all light radiated above a line 20 degrees below the horizontal through the lamp. Immediately this reduces the light available by 30 per cent., i.e., the efficiency drops to 70 per cent. This applies, of course, to both tungsten and fluorescent lamps. The lost 30 per cent. is absorbed by the material of the shade or trapped by multiple reflection within the shade. Even with a shade fitted the tungsten lamp gives a harsh light, i.e., it produces "hard" shadows which can cause distress to persons performing certain tasks. The effective cure for this is to fit a diffusing globe of opal glass, which in turn reduces the available light by another 20 per cent., leaving a useful net residue of 50 per cent. Here the fluorescent lamp scores heavily, as its surface brightness is so low that no diffusing glass is necessary.

Another factor affecting the C. of U. is the size of the area to be lighted. Fittings adjacent to walls lose a certain proportion of their light by absorption in the walls. Thus the smaller the proportion of fittings adjacent to walls, the better the C. of U. Obviously, too, the shape of the lighted area affects the coefficient, the highest value for a given area relating to a square room, the lowest to the extreme case of a corridor with one row of

Table 10.

EFFECT OF DIRT ON FITTINGS

Industry	Lm/sq. ft. with dirty reflectors	Lm/sq. ft. with clean reflectors	Per cent. increased illumination
Foundry ...	7	12	71
Foundry ...	4	5	25
Steel Works	2	3	50
Bench Work	42.5	105	147

This table, published in "Modern Factory Lighting" by the E.L.M.A. Lighting Service Bureau and B.E.D.A., gives illumination values obtained by a Government inspector before and after cleaning reflectors. It illustrates the very marked effect of dust and dirt on lighting fitting efficiency

lamps, each of which loses light to the walls.

Another variable appearing in the calculations is called the "Maintenance Factor." This allows for light loss due to dust and dirt settling on the fittings. For *good* maintenance conditions, the figure used is 0.8, i.e., 20 per cent. of the useful light from a fitting is assumed to be lost due to dirt before the fitting is cleaned. Obviously this figure must vary with the standard of maintenance and Table 10 illustrates what can happen.

In view of the large capital sums whose expenditure is called for by modern lighting standards, good planned maintenance is essential if a large part of the return from this capital is not to be wasted.

Having received a direction as to the financial policy to be followed, the engineer's next step in dealing with his relighting problem is to establish a programme of priorities. Beyond pointing out that the more densely populated areas (indicated in the survey schedule) should receive early consideration, this paper offers no help in this direction. Replanning of processes, renewal of wiring and distribution reinforcement, redecoration and fabric repair programmes all affect decisions on relighting priorities.

When a programme of sorts has been formulated, if this is to be completed within a reasonable period, a routine method of operation must be established.

Technical Advice

Lighting is a job for specialists, and the design of installations should be left to them. Fortunately for the engineer seeking assistance there are numerous firms of good standing which maintain staffs of competent lighting engineers whose services are available gratis to prospective purchasers of their fittings. It is suggested therefore that the only problem connected with the detail design of necessary new installations is the selection of one or more (but not too many) firms. In making this selection, the following remarks may be of assistance.

A great deal will depend on the supplier's local engineer. It is as well to ensure at an early date that he has a thorough knowledge of wiring and electricity supply design and economics. Based on this knowledge, his lighting designs will be economical and feasible.

and the purchaser's engineer will be saved much checking and design work. For example, in a working area without a ceiling it may be economical to use several extra fittings to maintain a symmetrical layout mounted on truss chords rather than to use the calculated minimum number of points and have to provide intertruss supports.

Then it is desirable that the firm selected should have a really local branch, including a stock room. The larger installations will be the subject of proper planning, but inevitably the engineer responsible for relighting will find himself beset by small lighting problems, requiring immediate treatment, and a local source of "one off" and "special" fittings ex-stock will prove invaluable.

No difficulty will be experienced in surveying the service offered locally by lighting firms. A telephone call will arrange an interview with a representative and a few competitive tenders will quickly determine those firms with whom business can most confidently be placed.

A few words on tenders and lighting schemes may be apposite at this point.

A surprising number of firms submit tenders and schemes which have been prepared at some central head office by men who have not been near the site. Sometimes, in the author's experience, these schemes are in direct contradiction to the suggestions made by their local engineer, who *has* seen the site and has assessed the various factors affecting a good lighting job which are difficult to indicate on a drawing. How a good design can be achieved by these methods is difficult to imagine.

From each tender and scheme submitted to him, the works engineer will wish to extract quickly (he is a busy man) certain key information. First, the cost—the whole cost clearly indicated. Not so many fittings at so much less this and that, plus so many auxiliaries at so much less something different, possibly complicated by alternative prices and types. Clarity in this part of a tender can help considerably.

Amongst other data, mounting height, designed illumination value, wattage of lamps, etc., are important, and whilst these are always mentioned somewhere in the text of the covering letter or report which accompanies a tender, all too frequently they are omitted from the plan of the installation with which the purchasing engineer is mainly concerned. Quite frequently the drawing with which a manufacturer is supplied for illumination design purposes is a general arrangement of the plant, crammed with a mass of information. To superimpose on this a pattern of lines, no matter how cunningly coded, to indicate lighting points is analogous to displaying needles on haystacks. Nice blobs of primary colour enable a layout to be seen at a glance, and all information can be tabulated in a clear margin. And when a sectional elevation has been provided, it should not be ignored when a layout is submitted.

Summary

To summarise, the engineer responsible for relighting a works has broken the back of his job when:—

1. He has a member of his staff capable of elementary lighting design and thus able to compare tenders.
2. He has high-level approval and finance for the line of action he proposes.
3. He has discovered a lighting firm or firms of repute with:—
   a. a competent local engineer.
   b. a local stockroom.
   c. sound ideas on the preparation and submission of tenders.

It cannot be too strongly emphasised that the purpose of this article is to indicate an approach to a problem. The data empirically selected happen, in this illustration, to make a strong case for the use of fluorescent lighting. The key data will vary with each individual problem and, in varying, may present a completely different conclusion to that which happens to have emerged from the purely illustrative figures used in this article.

This article was originally presented as a paper to the I.E.S. Liverpool Centre on January 4, 1949.

I.E.S. Annual Dinner

I.E.S. members are reminded that the annual dinner in London is to be held at the Café Royal, Regent-street, on Wednesday, May 11. Tickets, price 27s. 6d. each, may be obtained from the Secretary, The I.E.S., 32, Victoria-street, London, S.W.1.

Lighting in the T.S.S. Orcades

The new Orient liner Orcades, which recently completed her maiden voyage to Australia, embodies many new features and ideas in interior ship design. Her builders, Messrs. Vickers-Armstrongs, Ltd., and the Consultant Architect, Mr. Brian O'Rorke, A.R.A., F.R.I.B.A., who was responsible for the decorative designs, have given much thought to passenger comfort.

By reason of its construction, adequate illumination in the interior of a ship, even during daylight hours, is largely dependent upon the use of artificial light sources.

The first-class dining saloon on "F" deck is excellently lighted by two different types of unit. In the main area the lighting features are primarily indirect, taking the form of three parallel runs of pendant fittings, each unit housing two rows of three 4-ft. 40-watt lamps. A direct lighting component is obtained by means of diffusing "Perspex" panels, one per lamp, which permit a certain proportion of downward light to give slightly more life to the general appearance. In the alcoves at either side are single-lamp, semi-recessed louvred units, in keeping with those in the main area.

The library, which also serves as a chapel, is illuminated by means of a central laylight, panelled with 16 "Perspex" panels, 4 ft. by 8 in., to form a decorative feature of the room. The bookcases around the perimeter of the room are illuminated by a specially designed cornice unit, concealed above a false ceiling. The altar, normally enclosed behind the panelled doors is also high-lighted by means of a single 2-ft. 20-watt lamp concealed from view above the panelling itself.

The main decorative lighting feature of the first-class lounge runs fore and aft, and consists of three separate fittings, each housing three rows of three 4-ft. 40-watt warmwhite fluorescent lamps. The outer edge of each fitting is in the form of a lighted cornice, while the base of the fitting consists of a wide "egg box" louvre, behind which the central row of lamps is mounted, providing direct downward light. Flanking both sides of this feature, and still in the main area, totally indirect units each housing a 4-ft 40-watt lamp are mounted some 6 in. away from the ceiling, one to each ceiling area marked out by the shallow cross beams which break the monotony of a large expanse of ceiling. In each of the alcoves on the port and starboard sides a recessed unit accommodating one 4-ft. 40-watt lamp is positioned behind a dished surface-mounted framework enclosing a louvre. This lighting brings out the details of the various portraits and paintings which are hung in each of the alcoves.

The first-class lounge.

At one end of this lounge a large

The first-class restaurant.

mural extending across the full width of the central portion of the room is successfully highlighted by means of a continuous run of 4-ft. 40-watt lamps almost unnoticeable behind totally recessed grill - louvred fittings.

The first - class restaurant on " A " deck has totally indirect cornice lighting units in three large coves, the central feature being circular in shape, with those on either side in the form of a rhombus. Leading into the restaurant is an attractive foyer-lounge. The main lighting is obtained from a series of surface-mounted frameworks incorporating a grill-louvre, behind which are positioned single fluorescent lamps. Supplementary lighting i obtained from cornice units mounted around the extreme edges of the room behind a false ceiling. In addition to providing the required supplementary illumination these units serve the purpose of highlighting the curtain material which is used after nightfall to screen the window spaces which form almost entirely the walls of the lounge.

Throughout the first-class public areas, all foyers, stairways, etc., are illuminated by means of either fluorescent cove lighting or fluorescent units designed to harmonise with the lighting units in the rooms into which they lead.

The complete installation of fluorescent lighting was carried out with equipment supplied by the Metropolitan-Vickers Electrical Co., Ltd., by the ship's builders, Messrs. Vickers-Armstrongs, of Barrow. Some 492 fluorescent lamps are used in the vessel. All power for the lighting is obtained from a motor-alternator unit of 50 kva capacity.

The Electric Light Fittings Association

The annual report of E.L.F.A. for 1948 states that for reasons such as the continuance of purchase tax, electricity supply restrictions, limitations on capital expenditure, and continued high costs of production, the past year has not been an easy one for lighting fittings manufacturers.

Full statistics for 1948 of the total sales of all types of electric light fittings by the manufacturing side of the industry are not yet available, but during the first three quarters of the year home business, particularly on fluorescent fittings, declined considerably. The normal increase during the later part of the year may, however, counteract this decline. It is hoped that the increase in the issue of building licences for factories will stimulate a demand for industrial fittings. Similarly it is expected that the announcement by the Minister of Education that the programme of primary and secondary school building for 1949 is to be rather more than twice as big as that accomplished in 1948 will increase the demand for decorative and commercial fittings.

New Lighting Installations

General Office Lighting

An extensive lighting scheme was recently completed in the south wing general office of Messrs. Lever Bros. (Port Sunlight), Ltd. The installation was designed jointly by the engineers of Messrs. Lever Bros. and the B.T.H. Co. The actual installation was carried out by Lever Bros. staff.

As will be seen from the illustration, the building is of imposing dimensions, being 200 ft. long, 40 ft. wide, and having a "barrel" ceiling the maximum height of which is 30 ft. above floor level.

The original installation of local tungsten fittings gave uneven illumination and the apparent spaciousness of the building was greatly reduced at night. The attractively designed and carefully positioned fluorescent fittings which have superseded the tungsten fittings, provide excellent illumination throughout the office and leave the architectural form of the building unimpaired.

A total of 20 specially designed 15-ft. fittings, each housing 12 Mazda 80-watt daylight fluorescent lamps, are mounted in the frieze recess of the moulding between pilasters, at 24 ft. above floor level. Each fitting incorporates a metal reflector and is equipped with three "Perspex" diffusing covers which are hinged for simple lamp replacement. There are no glazing bars on these covers, and the impression of a single 15-ft. light source is, therefore, gained.

The control gear is housed on special panels in a ducting immediately behind the fittings, and is so arranged that each unit is in the same relative position as its associated lamp, and all wiring is parcelled in various colours to facilitate identification of circuits. The panels thus extend the whole 200 ft. each side, and are screened with expanded aluminium covers.

The installation is fed from a three-phase supply with a separate phase serving each 12-lamp fitting. A general light intensity of over 20 lumens per square foot is obtained and there is complete absence of disturbing glare and variations in light intensity.

General view of the south wing general office of Messrs. Lever Bros. (Port Sunlight) Ltd.

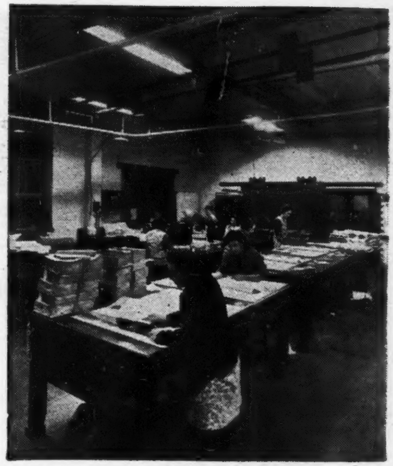
Printing Processes Under Fluorescent Light

A fluorescent lighting installation using 80-watt lamps has recently been completed in the flat-bed machine-room of Messrs. Speaight and Sons, Ltd., Ladbroke-grove. This section of the works is concerned mainly with letterpress and colour printing for a large number of well-known periodicals.

The 60 G.E.C. trough reflector fittings in the machine room are arranged so that the larger machines are lit by four, and the smaller by three, lamps, there being a lamp over the feeder and delivery ends of the machines in all cases, and either one or two placed intermediately. The lighting on the machines themselves, averaging 18 lumens per sq. ft., has been found fully satisfactory for working on the formes and cylinders when making ready, as well as for supervising the printing during the run. All the lamps are of daylight colour, which was chosen because of the necessity for accurate colour rendering in matching inks and supervising printing by the three-colour process.

Fluorescent lighting is being extended to other parts of the works, and the equipment of the folding and stitching room is now in progress. An illumination of 17-18 lumens per sq. ft. will be provided by the installation of 31 trough reflectors with 5-ft. 80-watt lamps. Another department where fluorescent lamps have been adopted with benefit to the staff is the composing room. At the present time this type of lighting is provided over the Ludlow slug-casting machines which serve the whole room, as well as above certain frames of Monocast type. It is understood that it is proposed to light the whole of the composing room with fluorescent lamps in due course.

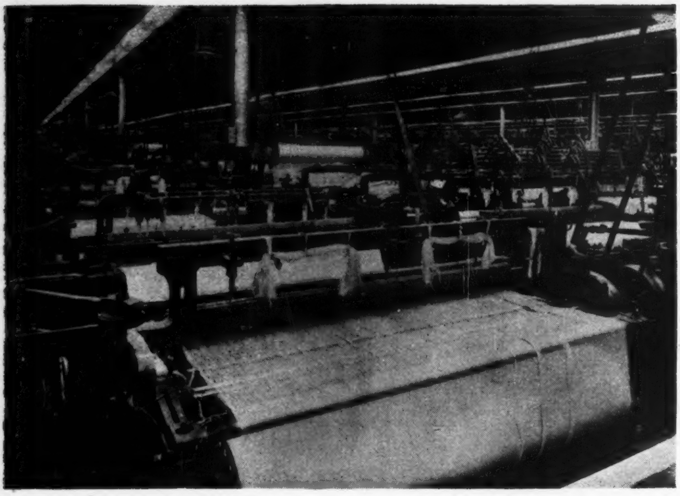
Illumination of Ludlow slug-casting machines.



Fluorescent lighting in folding and stitching room.

Lighting for Paper Manufacture

In the manufacture of high-grade papers every sheet of paper is examined for flaws and creases before it is allowed to leave the factory. Good seeing conditions are therefore important, and while daylight is considered the perfect medium, in winter time artificial lighting has to be used. Messrs. Alex. Pirie and Sons, Ltd., of Hylton, Sunderland, have installed some 60 Metrovick daylight fluorescent lamps for this work. The illumination on the working plane is 25/30 lumens per sq. ft., and has been favourably commented on by the girl scrutineers.



Showing an installation of Benjamin continuous troughing at Industry Mill Co. (Darwen) Ltd.

Manchester Exchange Hall

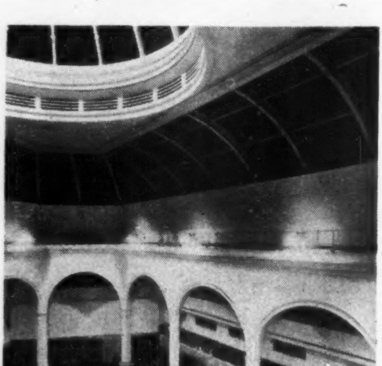
In the Corn, Grocery, and Produce Exchange Hall, Manchester, business is now carried out under illumination from a number of B.T.H. floodlight projectors. The installation work was executed by Messrs. Lomax Kendals, Electrical Engineers, Manchester. B.T.H. lighting engineers were responsible for planning the lighting scheme.

The Exchange Hall is a building of some size. Its domed ceiling is situated some 80 ft. above floor level, and the floor on which representatives of manufacturing, wholesaling and retailing firms meet to conduct business occupies approximately 8,000 square feet. The architectural features of the interior of this building are simple but impressive. Some 30 feet below the base of the domed roof there is a gallery encircling the hall and supported on decorative arches.

Most of the illumination at floor level is derived from 12 "Mazdalux" floodlight projectors mounted, at regular intervals, on the gallery rail. These projectors are general purpose units with a wide beam spread, and each employs a 1,000-watt tungsten lamp as light source. The body of the projector is constructed of an aluminium alloy which combines lightness with strength, whilst the reflector is of heavy gauge sheet steel treated with high quality white vitreous enamel inside and green outside. A safe lamp temperature is ensured by the incorporation of the B.T.H. patent heat baffle.

A 1,500-watt tungsten lamp mounted in a concentrating type reflector is installed in the centre of the ceiling dome.

This scheme has resulted in a congenial atmosphere throughout the hall.



I.E.S. ACTIVITIES

Newcastle Centre

At the meeting of the Newcastle Centre, on March 2, Dr. J. Ward, Head of the Mechanical Engineering Department of the Huddersfield College of Technology, gave his paper on "Engineering Applications of Polarised Light."

Dr. Ward commenced his paper by giving simple illustrations of the composition of polarised light and methods of polarising. He then went on to detail various applications of polarised light such as sun glasses, elimination of headlamp glare on cars, its use in connection with stereoscopic pictures, etc.

He then detailed the application of polarised light in connection with stress analysis, particularly photo-elasticity and at the same time described by the help of lantern slides various polariscopes which could be set up for photo-elastic research.

After detailing various transparent plastics which could be used in this connection, he then went on to discuss the stress optic law and the experimental verification of its accuracy as shown by the stress pattern in a disc under diametral compression. Again, by means of slides, he was able to give the interpretation of the fringe patterns obtained by stressing various engineering components.

There was a very good attendance of members and visitors, and the discussion raised many interesting points. This discussion was opened by Mr. Stringer, who is connected with one of the largest engineering firms on Tyneside, and he paid tribute to Dr. Ward's field of knowledge on the subject.

The first query to be raised was whether there was any guarantee of the stresses set up in a plastic material being the same as in metals, and, in reply, Dr. Ward indicated that the whole technique of photo-elasticity was based on the assumption that materials were homogeneous and isotropic. All comparisons were made on the basis that the stress picture in the plastic model was the same as in steel prototype providing the elastic limit was not exceeded.

It was also asked whether it was possible to resolve accurate stress concentration in connection with case-hardened tools, and also to calibrate the results. Dr. Ward indicated that it was possible to do this by using a compensator made up of two quartz wedges at right-angles, the result being accurate to 1/100th of a fringe. An alternative method would be to use a photo-electric cell to measure the intensity of the light at a point on the model. With an amplifier and galvanometer this would give readings to 1/100th of a fringe, but the disadvantage of this method is the cost of electrical parts of the apparatus.

One questioner raised the problem of the general use of polarised glass in car headlamps and windscreens, and Dr. Ward, in reply, admitted that there were very considerable difficulties in the way of operating this principle, but he referred to a report issued approximately 10 years ago which proved the great usefulness of this application.

Mr. Cardwell, of the Engineering Department of the Rutherford College of Technology, in proposing the vote of thanks to Dr. Ward, pointed out that the lecturer was in the forefront of research in connection with plastics and polarised light and congratulated him on his ability to present such an abstruse subject in so simple a way.

Tees-side Group

The sixth sessional meeting of the group was held on Wednesday, March 16, when Mr. E. J. G. Beeson delivered his lecture on "High Brightness Mercury and Mercury-Cadmium Light Sources."

The lecture covered the design, operation, and application of a number of light sources not usually encountered in the normal run of illuminating engineering, and much interest was aroused with the ingenious methods which Mr. Beeson had devised to enable the operation of various light sources to be seen on the screen.

Much interest was also shown in the demonstration of a 2½ kw. mercury discharge lamp suitable for operation from normal mains voltage and having none of the disadvantages of water or air cooling. Mr. Beeson explained that this lamp was now being produced together with the necessary control equipment

and reflectors for a trial installation, mixed with tungsten lighting, in a new building where the mounting height would be in the region of 70 ft.

During the discussion the general opinion of the meeting seemed to be that a 2½ kw. lamp was too large for industrial lighting needs. It was thought, however, that a discharge lamp rated at, say, 1 kw. would have an immediate and ready sale to the people in industrial areas like Tees-side, who are responsible for the installation of lighting in buildings which have mounting heights of 30/40 ft.

Scottish Centres

On March 17 and 18 the President, who was accompanied by the Secretary, attended the annual dinners of the Glasgow and Edinburgh Centres. The dinner at Glasgow was restricted to men only, the attendance being about 80, whilst at Edinburgh the ladies also attended. On each occasion after the dinner Mr. Waldram gave a brief and entertaining address.

The photograph at the foot of this page was taken at the Edinburgh Centre function by Mr. J. S. Galbreath, a member of the Centre. Mr. S. G. Batt, chairman of the Centre, was unfortunately unable to be present having recently taken up an appointment in the south of England.

Bath and Bristol Centre

The Bath and Bristol Centre held their annual dinner at the Grand Hotel, Bristol, on April 1, when the President and Secretary were again present. This event had been preceded in the afternoon by the annual general meeting of the Centre, when Mr. Waldram presented his Presidential Address.

After the dinner the toast of the Society was proposed by Mr. H. Midgley, Deputy-Chairman of the South-Western Electricity Board, who, in his remarks, said how much we all welcomed the removal of the restrictions on street, shop and sign lighting. Good lighting, he said, was not just a matter of bright lights and big lamps—the safety, health and happiness of people were often dependent on the proper use of light. How necessary then was it to have a Society to deal with such matters? Mr. Midgley also paid tribute to the work done in illuminating engineering by Mr. Waldram over a long period of years.

Mr. Waldram, replying on behalf of the Society, mentioned the high repute with which the Society is regarded in other countries. He also briefly reviewed the educational work of the Society, pointing out that the City and Guilds examinations were being increasingly recognised by both employers and employees in the lighting industry.

The toast of "The Guests" was proposed by Mr. W. C. Bowler, vice-chairman of the Centre, the response being made by Mr. C. M. Werry, chairman of the Bath Chamber of Commerce.

Entertainment during the evening was provided by the B.B.C. West Country Quartet.

Birmingham Centre

At a well-attended meeting on March 18, Mr. C. Harold Edlin, Assistant Director of the Forensic Science Laboratory of the East Midland Area, gave a lecture

Photograph taken at the Edinburgh Centre dinner. *Left to Right*—Mrs. Purvis, Mr. J. M. Waldram, Mr. H. D. Purvis, Mrs. G. E. L. Comrie, Mr. G. F. Cole, Mrs. J. S. Galbreath.

on Light and other Radiation in Crime Detection.

The C.I.D. man is a trained observer but any methods of observation which can take matters a stage further than can be reached by normal unaided vision are of value to such an investigator. Hence the detective's traditional magnifying glass, and the modern Forensic Science Laboratory's collection of apparatus, ranging from simple microscopes to spectrographs.

A consideration of the mechanism of normal observation shows that the process can be broadened and extended in a variety of ways. Instead of using normal white light for illuminating the object, we can choose from a wide range of possible forms of radiation. These include monochromatic light, infra-red rays, ultra-violet rays and X-rays. In using these radiations the eye must, of course, be replaced by suitable detecting apparatus, except in those cases where visible fluorescent effects result.

The straightforward examination and comparison of the physical features of objects is assisted by microscopes of all powers, by projectors, and by comparison microscopes. Photographic and photomicrographic processes are used for recording purposes, for bringing out certain details by increasing contrast, and for providing the observer with a more sensitive "eye" by giving prolonged exposures. Optical methods are used in making precision examinations and comparisons of the physical properties of certain substances, such as minute fragments of glass. Infra-red rays are often reflected and absorbed in a characteristic manner by many common materials; this effect and the penetrating property of the rays, make them particularly useful in the examination of documents. Ultra-violet rays in the region of 3,600A are able to excite fluorescence effects in many common substances. Also they are frequently reflected in an unexpected way by many materials; these two properties render their use a potent weapon in the examination of documents, stains, and a large variety of objects.

The spectrograph is particularly useful in a Forensic Science Laboratory as it can very often be applied in the examination of minute traces left when two objects have been in contact. Emission spectrography in the visible and ultra-violet region down to about 2,000A is continually being used in the examination of traces of metals and other substances such as paint. The metallic arc, the condensed spark and the high frequency spark are used in this work. Absorption spectra also give useful information about certain substances.

Mr. Edlin dealt expertly with points raised during the discussion and a vote of thanks proposed by Mr. S. D. Lay and seconded by Chief Inspector Burgess was passed with acclamation.

I.E.S. Meetings

LONDON

May 10th

Annual General Meeting, followed by an Address by Monsieur L. Gaymard in the Lecture Theatre of the Royal Society of Arts, John Adam Street, London, W.C.2. 6 p.m.

May 24th

Visits to Glassworks: (i) Chance Brothers, Birmingham; (ii) Osram-G.E.C. Glassworks, Wembley.

(Places on these visits on application to the I.E.S. Secretary.)

CENTRES AND GROUPS

April 25th

Annual General Meeting and Presidential Address by Mr. J. M. Waldram. (At the Medical Library, The University, Western Bank, Sheffield.) 6 p.m.

April 28th

Film Evening. (At the Demonstration Theatre, of the East Midland Electricity Board, Charles Street, Leicester.) 6.30 p.m.

April 29th

Birmingham Centre Visit to an Industrial Plant.

April 29th

Film Evening and Annual General Meeting. (At the Electricity Showroom, Market Street, Huddersfield.) 7.15 p.m.

May 12th

Annual Luncheon followed by Annual General Meeting. (At the Royal Hotel, Cardiff.) 12.30 p.m.

May 12th

Annual General Meeting and Smoking Concert. (At the Demonstration Theatre, of the East Midland Electricity Board, Charles Street, Leicester.) 6.30 p.m.

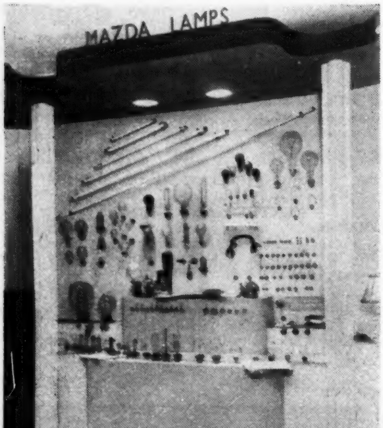
May 12th

Mr. S. Anderson on Circuits and Auxillary Gear for Discharge Lighting. (At the Lecture Hall, Brighton Technical College, Brighton.) 7.30 p.m.

New Lighting Showrooms

The B.T.H. Company officially opened a showroom for lamps and lighting equipment at its London office, Crown House, Aldwych, on March 16.

It is sub-divided so that all fittings and lamps are grouped to indicate the latest designs for industrial, decorative, domestic, transport, marine and street lighting. The Mazda lamps exhibited range from the smallest types used in automobile lighting to projector lamps of 10,000 watts.



There is also a section on auxiliary gear.

It is hoped that this new showroom will demonstrate to both home and overseas buyers all the latest developments of the B.T.H. Company in the vast and varied field of modern illumination.

The above photographs show two views of the showroom, a general view and the "Mazda" lamp section.

The illustration below shows one corner of the re-designed showrooms of the Sun Electrical Company, Ltd., in Charing Cross-road, London. These premises suffered severely from bomb damage in 1941, as a result of which showroom space had to be restricted. The present showrooms are intended to help electrical contractors by showing fittings which, though in constant demand, are outside the capacity of the average contractor's showroom.

Lighting at London Airport

The instrument landing runway at London Airport, Heathrow, has been equipped with an approachway of G.E.C. low-intensity approach lights. These lights, which are arranged for pole-top mounting, have their light distribution in the form of a narrow beam 4 deg. above the horizontal and showing through 360 deg. in azimuth. Thus the approachway is visible to an aircraft approaching from any direction, and to aircraft on the circuit.

The G.E.C. has also supplied the high-intensity runway lights, which have been specially developed as part of a high-intensity visual landing scheme that will eventually keep the airport in operation even if visibility drops to 200 yards by day or 100 yards at night. The lights are recessed into the runway. Having a projection of only two inches above ground level, and a smooth contour, the fittings present no obstacle to aircraft, while the design is such that stresses on the domed cast-iron top due to aircraft running over them are not transmitted through the glass ring through which the beams are emitted.

A special arrangement of the optical system and reflectors produces a beam in each direction along the runway with a maximum intensity of over 5,000 candle-power. The distribution of intensity is such that the maximum assistance is given to the pilot, while the light emitted in directions away from the approaching aircraft is limited, in order to avoid halo effects in foggy weather.

Threshold lights, at each end of the runway, are special versions of the runway light with the addition of colour screens.

Instrument landing runway illuminated by G.E.C. high-intensity runway lights.

One of the taxiway lights for guiding aircraft to and from the runways and dispersal areas.

The taxiway lights for the numerous routes that aircraft follow from the apron to the runways and dispersal areas, were also supplied by the G.E.C. These lights have their distribution concentrated into a narrow beam a few degrees above the horizontal, and their visibility in azimuth can be limited through any number of degrees to suit their particular location. Colour filters can be fitted inside the lights, and those at London Airport are equipped with blue filters.

New Cold Cathode Tube

Increased possibilities in devising cold cathode lighting schemes to suit particular colour-rendering requirements are opened up by the introduction of a new Ivory cold cathode tube in the Osram range. This tube, known as Ivory No. 40, can be used in conjunction with Gold tubes to produce a very pleasing mellow light that harmonises effectively with tungsten lighting.

Transfer of Philips' Lamp Factories

The electric lamp factory of Philips Electrical, Ltd., now situated at Harlesden, London, where lamp production running into many millions per annum is achieved, is to be moved to Hamilton in Lanarkshire, Scotland. The Harlesden factory employs 500 men and women and was originally acquired by Philips 23 years ago.

The transfer entails the removal of all equipment, and will be completed over a period of months. Equipment is being moved in complete sections so as to have the minimum effect on production for home and export requirements.

While the tungsten and discharge lamp section of the company's lamp production is being transferred to Hamilton, it is also proposed to transfer fluorescent lamp manufacture from Blackburn to Hamilton so as to centralise the manufacture of Philips's lamps.

Some equipment is already on the way to Scotland, where workers are to be trained in lamp manufacture. The first lamps will be produced at the new works by the middle of March. It is expected that the whole move will be completed by the end of September, 1949.

The Harlesden lamp research laboratories and Blackburn Quality Dept., under Dr. Thomas Holmes, M.Sc., Ph.D., are also involved in the transfer. The laboratories will be represented in nucleus as soon as production starts in Scotland, and its tranfer will be complete by July.

British Industries Fair

The 1949 British Industries Fair is to be held from May 2-13, the Engineering and Hardware Section being at Castle Bromwich, Birmingham, as on previous years.

It is understood that the following are amongst those exhibiting lighting equipment at Castle Bromwich:—

Aladdin Industries, Ltd.; British, Foreign and Colonial Automatic Light Controlling Co., Ltd.; The British Thomson-Houston Co., Ltd.; Crompton Parkinson, Ltd.; Davis Bros., Illuminating Engineers, Ltd.; Ekco-Ensign Electric, Ltd.; Falk Stadelmann and Co., Ltd.; The General Electric Co., Ltd.; Hailwood and Ackroyd, Ltd.; L. G. Hawkins and Co., Ltd.; Joseph Lucas, Ltd.; Longlamps, Ltd.; Neon Electric Co., Ltd.; Oldham and Son, Ltd.; Osborn Manufacturing Co., Ltd.; Revo Electric Co., Ltd.; Sangamo Weston, Ltd.; Simplex Electric Co., Ltd.; Thorn Electrical Industries, Ltd.; Tilley Lamp Co., Ltd.; Walsall Conduits, Ltd.

British Street Lights in Copenhagen

Over a mile and a half of the GL. Koge Landvej arterial road leading out of Copenhagen has been equipped with high-pressure mercury vapour lighting, using G.E.C. "Dioptrion" lanterns. The installation was carried out by Messrs. Louis Poulsen and Co., A/S., agents for the General Electric Co., Ltd., and was planned with the co-operation of the Copenhagen Municipality Street Lighting Department. Each lantern contains

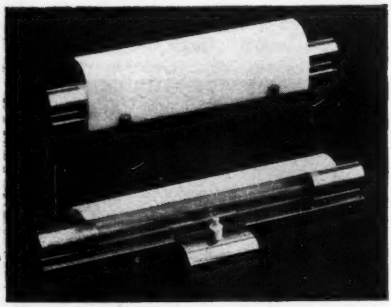
a 250-watt H.P.M.V. lamp, burning horizontally.

All the lanterns are suspended above the centre of the road on spanwires at a height of 28 ft., and are spaced 120 ft. apart. The carriageway is 40 ft. wide from kerb to kerb, and an illumination of over 5,000 lumens per 100 ft. linear is provided. It is flanked on each side by a cycle track and pavement, making the total width of the highway 84 ft.

LIGHTING FITTINGS

WEMBLEY ELECTRICAL APPLIANCES, LTD., announce the introduction of their "Wealite" local lighting unit. This fitting incorporates a 2-ft. 20-w. fluorescent lamp housed in a reflector to give an even spread of light on the working plane. The base of the fitting and the reflector are joined by three articulated tubular arms, swivel joints allowing the lamp to be used in almost any angle. A clamp and wall-mounting bracket are provided as an alternative to direct mounting, and provision is made for cable entry. The total weight is 8 lb.

The illustration shows two new LINOLITE decorative fittings, the WL.4 (top) and the WL.5.D. These fittings use a neat 'Perspex" shade which is available in various colours and can be em-



Linolite decorative fittings.

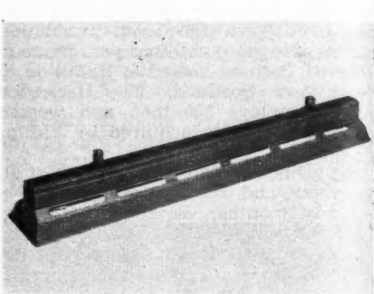
ployed for upward or downward lighting. They are particularly useful for lighting bed-heads, mirrors, alcoves, etc.

The prices of these fittings are:

WL.4. In chrome, 41s.; in bronze, 35s. 6d.

WL.5 (U. or D.). In chrome, 49s.; in bronze, 43s. 6d.

New Fluroliers introduced by the BENJAMIN ELECTRIC, LTD., include the types "F" and "FF," the latter being shown in the illustration. Both are designed for use with 5-ft. (80-w.) fluorescent lamps. Each unit is in two parts, the reflector, which is finished in Crysteel vitreous enamel, grey outside and white inside, being detachable from the wiring channel which accommodates the control gear. Type "FF" is designed for

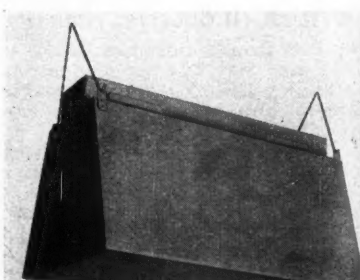


Benjamin Flurolier type "FF."

use when some upward light is required, and this is obtained by means of six slots on each sloping face of the reflector. Due to the wide variety of fixing facilities with these fittings they are easy to erect and relamping can be carried out by one man.

The illustration below shows the SIEMENS colour-matching unit, which gives a close approximation to north-sky daylight for accurate colour assessment.

THE GENERAL ELECTRIC CO., LTD., has introduced a new Osram 5-ft. colour-matching lamp to serve as a substitute for natural daylight in operations involving the handling or matching of coloured materials and objects. In spectral distribution the lamp conforms closely to the accepted standard for artificial daylight. The new colour-matching lamps are suitable for use with fittings and gear designed for the existing



Siemens colour-matching unit.

range of Osram 5-ft. 80-w. lamps, but for colour-matching purposes it is usually advisable to employ a trough reflector immediately over the work to avoid modification of the spectral distribution by reflection from nearby coloured surfaces.

The price of this colour-matching fluorescent lamp is 17s., plus 5s. 3d. purchase tax.

Catalogues Received

REVO ELECTRIC CO., LTD. — Street Lighting Equipment for sodium, mercury, fluorescent and tungsten filament lamps. Includes details of fittings, isocandle diagrams, etc.

METROPOLITAN - VICKERS ELECTRICAL CO., LTD.—Catalogue and price list of complete range of Metrovick and Cosmos lamps.

R. & A. G. CROSSLAND. — Range of lighting fittings for tungsten and fluorescent lamps for industrial, commercial and decorative use.

THE EDISON SWAN ELECTRIC CO., LTD. —Leaflet giving details of "Ensur-a-lite" equipment for providing emergency lighting.

The EDITOR Replies

From time to time we are asked by readers to suggest a solution of their special lighting problems. It is not possible to do this in any detail on this page. Few of these problems are really new; usually they resemble others for which a successful treatment has already been applied by someone. It would, therefore, be useful to collect and classify these "special" problems and their solutions, and to publish them in a companion booklet to the I.E.S. Code.

As a matter of fact, the Code Committee of the I.E.S. already have this matter in hand, though it will be appreciated that the compilation of this booklet will involve considerable labour and inquiry, and it is not yet possible to indicate how soon publication can be made. Readers can assist the committee in this task by bringing to their notice any special problems they personally have encountered and giving a brief analysis of these problems and description of what has been done to meet the situation.

The I.E.S. Code itself—which is now out of print—has been revised and will soon be re-issued. The new edition is to have the pages uniform in size with those of British Standards Specifications, and a coloured stiff paper cover is to be used. Another innovation will be a colour background to the well-known Illumination Charts, which are such distinctive features of the Code. Since 1945, when the Code was first published in its present form, some 10,000 copies have been issued.

While we are giving advance information, readers may like to know that several new books by well-known members of the I.E.S. are "on the stocks." At least three of these books have been completed by the authors, although, as yet, no publication dates are known.

Lighting engineers—who are necessarily "contrast-conscious"—have no doubt noted with interest the parallel bar pattern recently introduced on some of our roads at pedestrian crossings. If this is to be a permanent feature of road crossings, the contrast must be well maintained. The superficial marking adopted for "Road Crossing Week" rapidly deteriorates in heavy-traffic streets, but doubtless it is only a temporary expedient. The lighting of pedestrian crossings at night is one of the problems of the street lighting engineer and, incidentally, we understand that one of the books referred to above is on the subject of street lighting.

Following the suggestion of a word meaning "lumen per square foot" which we published in our last issue, another term has been proposed. The proposer points out that the term "candela" has recently been introduced into the vocabulary of lighting, and he suggests that if the two terminal letters of "lumen" are replaced by the first letter of the alphabet, the resultant word, "luma," is quite suitable as a designation for the unit of illumination. Apart from the precedent which he cites for forming the name of the unit in this way, he suggests that "a" is an appropriate terminal letter because it stands for "area," and it is understood that the area involved in the unit designated is the square foot. Moreover, "luma" is more euphonious than either "luf" or "luft," while, unlike "lume," the written word cannot be mis-read nor the spoken word mis-heard for "lumen." There may be objections to "luma" which are not apparent to our correspondent, but we confess his suggestion commends itself to us as the best so far.

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